CLAM-ABALONE SPAWNING AND REARING

COMPLETION REPORT
July 1, 1970 to June 30, 1973

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Introduction

Laboratory studies of the Manila littleneck clam (*Venerupis semidecussata*) continued during the 1972-73 project year. Attempts were made to improve the conditioning procedure for adult spawners and to increase growth of juveniles held in laboratory trays. Field studies included the establishment of new Manila littleneck test plots and a survey of estuarial areas which offer a potential for future Manila clam plants. Experimental Manila and native clam test plots established during the project year and prior years were monitored.

Adult red abalone (*Haliotis rufescens*) needed for spawning experiments were obtained from Whale Cove, the southern Oregon coast, and Fort Bragg, California. Juvenile red abalone, planted in Whale Cove in 1967, were sampled for growth.

Clam Studies

Methods

Clam Spawning, Larval and Juvenile Rearing

Procedures for spawning and rearing Manila littlenecks were similar to those used in previous years (Lukas, 1972). New conditioning procedures were developed to reduce the amount of time spent inducing the adults to spawn. Each group of Manila adults (60 per group) to be used for spawning were sexed by withdrawing a sample from an individual clam's gonad and examining it under a dissecting microscope. The clams were placed in two trays by sex and preconditioned one to seven days with water temperature in the trays maintained at 15 C by means of a water immersion heater controlled by a thermoregulator. After this period, an additional heating element was placed in the conditioning tray. This element, attached to a time clock, heated the water to 17 C for six hours daily for two days. Following this, the temperature was increased to 19 C for a six-hour daily period for two days and finally to 21 C for a six-hour daily period for two days. After this conditioning procedure, the clams were then induced to spawn.

It has not been possible to get uniform distribution of circulating raw sea water through the shallow 100 liter fiberglass trays (51 x 27 x 6-inches deep) used for rearing Manila juveniles. Juveniles show variable growth depending on where they are situated within a tray. To eliminate this uneven growth, plexiglass partitions were added to direct the water flow throughout the tray (Figure 1).

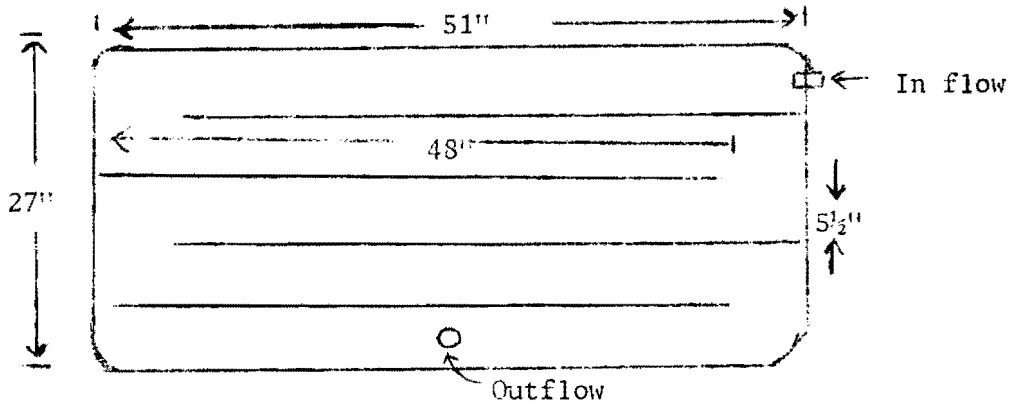

Figure 1. Placement of Plexiglass Partitions in Fiberglass Rearing Trays (top view).

The 1/8-inch thick partitions were attached to the tray with non-toxic silicone seal. Growth of Manila juveniles held in trays, with and without partitions, was compared after a three-week period.

Field Studies - Manila Littleneck Clams. Experimental plots were established in two estuaries, Yaquina and Alsea.

Manila juveniles were planted in two areas in Yaquina Estuary. A 50-square foot plot was established on the west side of Sally's Bend. The plot was planted with 2,500 juveniles (50 clams/sq. ft.) in October 1972. The juveniles averaged 6.2 mm and ranged from 4.0 to 10.5 mm.

Manila juveniles were also planted seven miles upstream from the mouth of the Yaquina Estuary on the north shore. Three 36-square foot plots were established approximately 200 yards apart with tidal height ranging from 3.2 to 5.0-feet above mean lower low water. Each plot received 1,800 Manila juveniles (50/sq. ft.) averaging 6.7 mm.

Experimental plots were established in two areas in Alsea Estuary approximately 2 miles upstream from the mouth and on the north shore. One plot measured 5 x 40-feet and was planted with 10,000 Manila clams (50/sq.ft.) averaging 5.6 mm. Tidal height ranged from 0.4 to 4.4-feet above mean lower low water. Four small plots were established 200 yards upstream from the first plot. Each of these plots measured 6 x 6-feet. They were set up in a line perpendicular to the shore line and located at 1.8, 2.8, 4.1, and 5.1-feet above mean lower low water. Each plot received 1,800 juvenile Manila clams (50/sq.ft.) which averaged 5.6 mm.

A gravel bar south of the breakwater in Yaquina Estuary was selected as a site for introduction of a large number of juvenile Manilas. The test plot in this area was the only one of five plots in five different estuaries which showed good survival when sampled in the spring of 1972. A 3,800 square foot area received 426,000 juvenile Manilas. These clams ranged from 3.0 to 13.7 mm and were planted at densities ranging from 97 to 156/sq. ft.

Results

Clam Spawning, Larval and Juvenile Rearing

The new conditioning procedure of temperature manipulation was successful in shortening the time spent on inducing adult Manilas to spawn. Previously, clams would not spawn until three to five days of working with them. With the new procedure, males would almost always respond to spawning inducements on the first day following conditioning and frequently one or two females would also spawn. On the second day, enough eggs usually would be obtained to satisfy our needs.

One problem with the procedure was that on certain occasions the clams would spawn in the conditioning tray the evening following the first day of spawning inducements. Placing the clams in a cold water bath (10 C) overnight did not prevent spawning. These clams would spawn out completely.

A situation developed in September and October 1972 in which the sea water coming into the laboratory apparently was toxic. The eggs obtained in September had very poor survival and in October the adult Manilas did not spawn at all. Toxic bay water has been observed seasonally at the pilot oyster hatchery operation at Oregon State University's Marine Science Center from June through October. The duration and frequency of occurance of toxic water has not been consistent however, In 1971, the oyster hatchery was unable to produce Pacific oyster seed from the last week of June through September 7 (Dennis Lund, personal communication). Sand and carbon filtration and treatment with chelating agents have not been effective in detoxifying the water. It is suspected that the die-off of plankton blooms may put toxic material into the water.

Personnel operating the oyster hatchery were able to successfully spawn native and European oysters during the summer of 1971 showing that certain species are tolerant to this phenomena.

Juvenile Manila clams averaging 2.7 mm were used to test the effectiveness of a shallow tray with partitions in improving growth. After three weeks, juveniles in the tray without partitions averaged 3.0 mm while those in the tray with partitions averaged 4.4 mm. The trays have to be well supported since the weight of the water causes the bottom to sag and pull away from the partitions. Our trays were supported by four 2 by 4's on edge directly beneath each of the partitions.

Field Studies

Manila Littleneck Clams. The 5 x 10-foot plot established on the west side of Sally's Bend in Yaquina Estuary was sampled in April 1973. No live Manilas or empty shells were found. The area showed no signs of being eroded or scoured. We found juvenile cockles, averaging 3.7 mm in rib length, in the plot at a density of 5/sq. ft. The presence of these juveniles was an indication that the substrate of the plot was stable.

Three plots in Yaquina Estuary established seven miles upstream were sampled twice; once in September 1972 and again in April 1973 (Table 1). The mean lengths of the juveniles increased 7.8 to 9.7 mm in nine months. Survival of clams after the first month in the plot was over 50%, but after nine months percentage survival ranged from 12.8 to 34.4. The tidal height of plot C at its lower boundary is estimated to be 4.3-feet above mean lower low water while the upper boundary is 5.0-feet. There was a difference in survival between the upper and lower areas of this plot. Clams in the upper section of the plot had a survival rate of 2.7% and an average length of 13.5 mm while those in the lower section had a survival rate of 38.7% and an average length of 15.1 mm.

Table 1. Mean Shell Length and Percentage Survival of Manila Littleneck Clams, One and Nine Months after Planting in Yaquina Estuary.

	September 5, 1972		April 23, 1973	
Plot	Mean Shell Length (mm)	Percentage Survival	Mean Shell Length (mm)	Percentage Survival
A	10.5	55.0	16.4	34.4
B	9.8	83.0	14.5	12.8
C	-	-	15.0	21.7

An experimental Manila clam plot was established near Riverbend (approximately 5.5 miles upstream from the mouth) in Yaquina Estuary to test the effects of clam size and density on survival (Lukas, 1972). This plot was sampled twice; in September 1972 and May 1973 (Table 2). The sample in September was too small to obtain a meaningful figure on survival. The May sample was larger and indicated a survival rate ranging from 0 to 2.2%. However, the plot was extensively honeycombed with shrimp burrows. This large population of shrimp probably had an effect on the survival of the planted clams since their activity has made the substrate unstable. Two empty Manila shells were found which had the margins broken and chipped indicating predation by crabs.

The lengths of the live clams recovered indicated that in this area clams were able to achieve good growth.

Table 2. Mean Shell Length of Manila Littleneck Clams Five and Twelve Months after Planting in Test Plots near Riverbend, Yaquina Estuary.

Group[1/]	Mean Length When Planted (mm)	September 6, 1972 Mean Shell Length (mm)	May 4, 1973 Mean Shell Length (mm)
1	11.0	23.3	31.7
2	6.5	22.6	32.0
3-A	3.7	22.0	28.2
3-B	3.6	19.1	26.9

1/ All groups except 3-B were 16 months old. The 3-B group was 4 months old.

After 12 months in the plots, the mean shell lengths of the four groups of clams were greater than those of other clams planted in experimental plots in Oregon estuaries. These averages are also slightly greater than the average lengths of Manilas after 12 months in the substrate at Hood Canal in Washington (Nosho and Chew, 1972).

Groups 1, 2, and 3-A were the same age but had different growth rates in the laboratory. After 12 months, the group of large clams did not continue to maintain rapid growth. The group of small clams (3-A) were able to maintain a nearly similar growth rate. Group 3-B, 1 year younger than group 3-A, was able to achieve, in the laboratory, a mean length in 4 months which took group 3A, 16 months to achieve. However, after one year in the plot, their growth rates were comparable.

The experimental Manila plot near the breakwater in lower Yaquina Estuary was sampled in April 1973. This plot was established in September 1971. Sampling in May 1972 indicated an average survival of 16.5% and a mean shell length of 10.5 mm (Lukas, 1972). Mean shell length in April 1973 was 18.3 mm with an average survival of 6.1% (Table 3). As in 1972, growth and survival varied according to the location of the clams in the 10 x 40-foot plot.

Table 3. Mean Shell Length and Percentage Survival of Manila Littleneck Clams in Experimental Plot near the Breakwater in Yaquina Estuary, April 11, 1973.

Sub-Plot	Tidal 1/ Height (ft)	Mean Shell Length (mm)	Percentage Survival	Percentage Survival 2/ Since May, 1972
A	3.9-3.8	15.0	9.2	30.7
B	3.9-3.9	13.0	6.4	35.6
C	3.8-3.9	14.2	3.4	24.1
D	3.6-3.8	19.0	11.6	55.8
E	3.1-3.6	22.1	6.4	72.7
F	2.8-3.1	23.7	6.4	72.7
G	2.2-2.8	27.0	3.2	42.1
H	1.7-2.2	21.8	0.5	66.7
Total Plot Average		18.3	6.1	

1/ Height above mean lower low water.

2/ Percentage survival calculations based on the number of clams in each sub-plot in May 1972 (Lukas, 1972).

Growth continued to be better in the lower portion of the plot where the clams are submerged a greater portion of the time. The clams in the lower portion of the plot also had better survival in the last 11 months compared with those in the upper part of the plot.

The experimental plots re-established in Alsea Estuary in June 1972 were sampled twice during the project year; in September 1972 and in May 1973. Clams in the 5 x 40-foot plot showed, in September, a survival of 10% nearly three months after being planted. Average length of the clams was 10.5 mm. The plot was sampled in May 1973 and only one live 17.6 mm Manila was found.

The four 6 x 6-foot plots when sampled in September indicated that the clams were growing well in the lower three plots (Table 4). The tidal height of the upper plot was too high to allow the clams to achieve good growth. Subsequent sampling in May revealed that the clams which did survive grew well. However, survival was poor.

Table 4. Mean Shell Length and Percentage Survival of Manila Littlenecks in Alsea Estuary, Three and Ten Months after Planting.

		September 8, 1972		May 1, 1973	
Sub-Plot	Tidal Height (ft) 1/	Mean Shell Length (mm)	Percentage Survival	Mean Shell Length (mm)	Percentage Survival
1	5.4	7.4	24.0	-	0
2	4.1	11.1	11.3	-	0
3	2.8	13.3	40.6	19.7	2.4
4	1.8	13.2	10.0	19.4	0.8

1/ Approximate height of upper boundary of plot above mean lower low water.

Native Littleneck Clams. In September 1970, juvenile native littleneck clams, (*Venerupis staminea*), were planted in Yaquina Estuary in a plot containing various substrates (Phibbs, 1969). This plot was sampled during May of 1971 and 1972 to assess growth and survival. By May 1972, the entire plot had been sampled. Recovered clams were replanted. The sample made in April 1973 was to determine growth only as it was not possible to determine mortality associated with handling and replanting. The native littlenecks sampled in April 1973 had an average shell length of 37.4 mm. These clams were nearly 42 months old and had been in the plot 30 months (Figure 2).

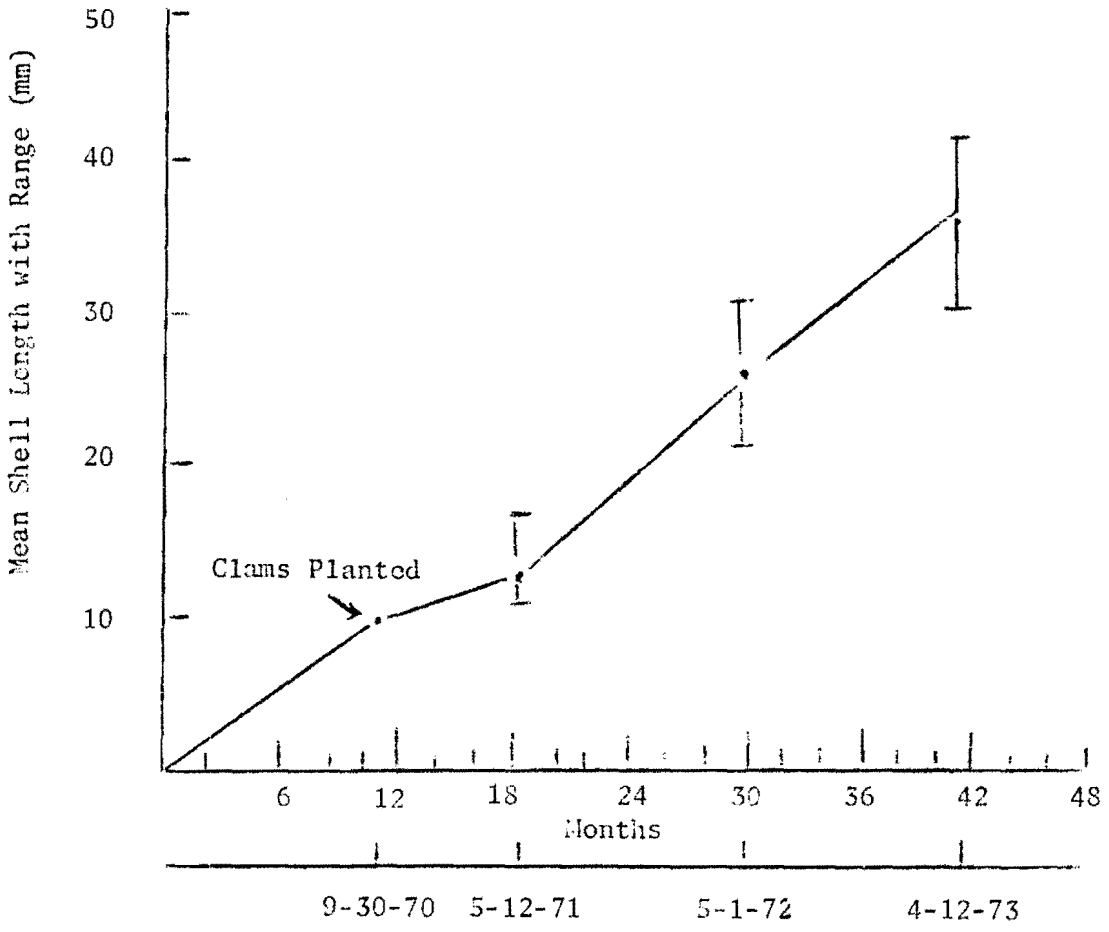

Figure 2. Growth Curve of Native Littleneck Clams Planted in Artificial Substrate Plot, Yaquina Bay.

Butter Clams. Juvenile butter clams (*Saxidomus giganteus*) were planted in the artificial substrate plot in December 1968 (Phibbs, 1969). When sampled in April 1973, the clams were nearly five years old and had been in the plot 52 months. The average shell length of these clams was 60.1 mm with a range from 54.4 to 67.5 mm (Figure 3).

Discussion and Conclusions

Clam Spawning, Larval and Juvenile Rearing

The development of the new conditioning procedure has saved time in inducing the adult Manila littleneck clams to spawn. However, the occasional spawning of the clams in the evening, after a fruitless day of spawning attempts, indicates that the proper combination of spawning inducements has not been achieved. As yet no consistent pattern of clam response to spawning stimuli has been noted. When the female clams do spawn in the conditioning tray overnight, the survival rate of the salvaged eggs is very poor. Since the females apparently spawn completely on these occasions, it is necessary to begin conditioning a new group of adults.

Toxic bay water, which apparently affects the spawning of Manila adults and survival of the larvae, was not mentioned as a problem during the spawning and rearing of 5 native species by the previous investigator working on this project. It may be that the Manila littleneck, not indigenous to this area, has not developed an immunity to the toxicity. The spawning of Manila adults in the laboratory will have to be scheduled to occur outside of the June through October period.

The addition of the partitions in the shallow fiberglass trays helped to increase growth of Manila juveniles exposed to raw sea water circulation.

Field Studies - Manila Littleneck Clams

One of the limiting factors in establishing the Manila littleneck in Oregon estuaries has been the lack of suitable habitat. There are areas which appear to

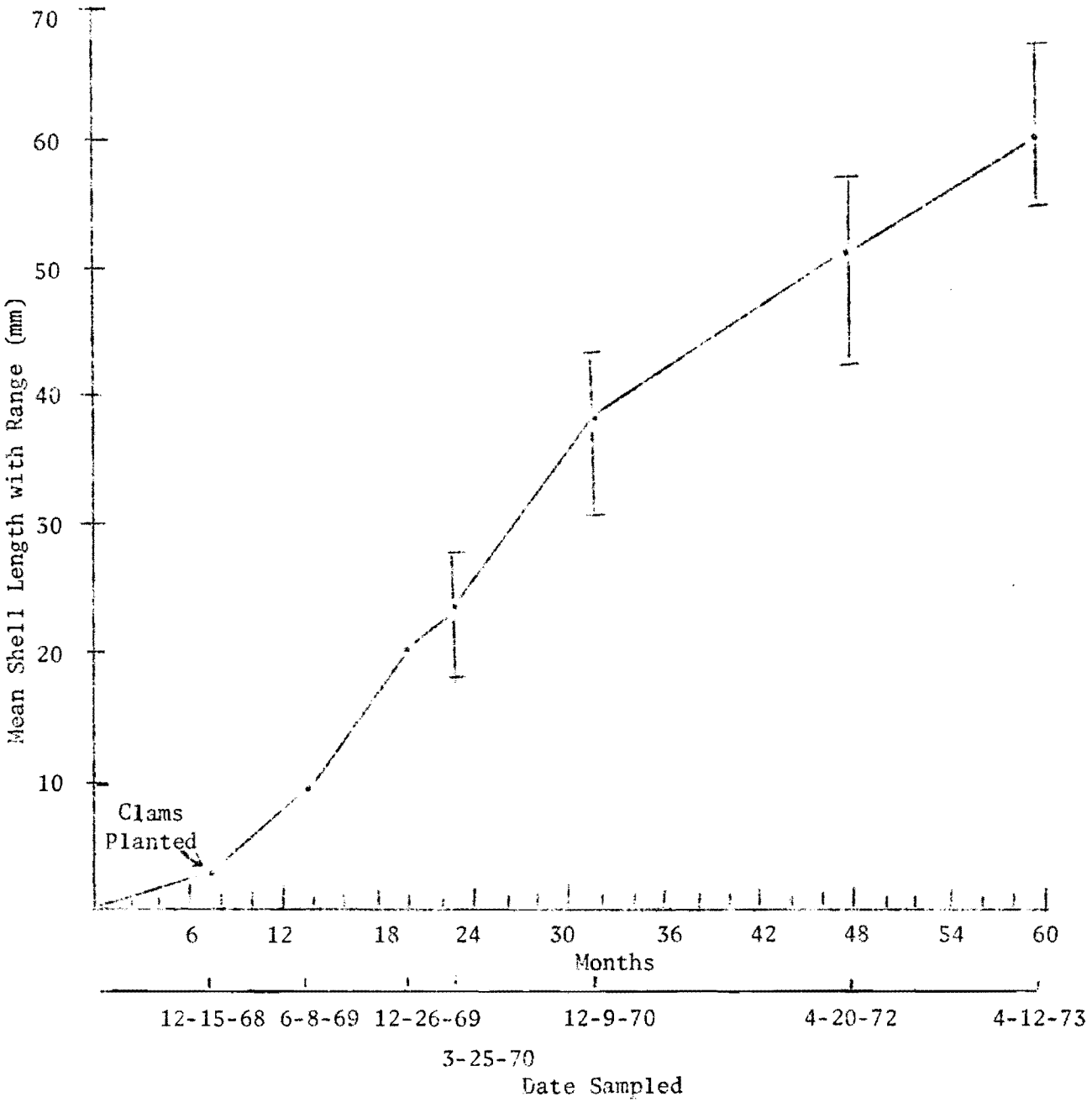

Figure 3. Growth Curve of Butter Clams Planted in Artificial Substrate Plot, Yaquina Bay.

have suitable substrate, but mortalities in test plots in these areas approach or are 100 percent. Examples of this were seen at Sally's Bend and Riverbend in Yaquina Estuary and in the test plot on the Alsea Estuary.

Mortalities may have been related to weather conditions during the winter. In December 1972, there was a period of 7 days of subfreezing temperature which may have had some effect on the survival of juvenile Manilas high on the tide flat. Other than this period in December, the winter of 1972-73 was relatively mild with less than normal rainfall and there were no periods of prolonged freshets which could have been a factor in clam mortality. The juvenile Manilas in the test plots which did survive have shown average growth indicating an adequate amount of food available.

Manila clams in the three plots in upper Yaquina Estuary varied in survival which may have resulted from differences of the substrate and/or burrowing shrimp activity. The Manila clams in these plots achieved less than average growth probably because the plots were at too high a tidal level. The clams could not be planted below 3.0-feet above mean lower low water in this area because of the occurrance of a thick layer of silt.

The poor survival of the clams in the upper portion of plot C indicates that in this area of the estuary a tidal height approaching 5.0-feet above mean lower low water is the upper limit for Manila planting.

The experimental size-density plots near Riverbend were within a tidal range of 0.7 and 1.4-feet above mean lower low water. The clams in these plots achieved good growth even though survival was poor. One of the objectives of this study was to determine if the faster growing laboratory-reared clams could maintain a faster growth rate in the field. Even though our sample size was small, the data indicates that the small clams were able to achieve a growth rate comparable to the medium and large size clams (Groups 1 and 2). It appears that the differences in growth of clams are the result of our labroatory technique.

The activity of burrowing shrimp and the poor survival of the Manilas are probably related. Tests need to be made to compare clam survival in an area in which the shrimp have been eradicated.

The growth of the Manila juveniles in the experimental plot on the breakwater in Yaquina Estuary has been less than the growth of Manilas in other plots in the estuary. The tidal height of the plot and location in the estuary may have an influence on growth. The clams in the upper portion of the plot have a significantly smaller mean shell length than clams from lower portions of the plot. The estuary area near the mouth, being cooler than the upper estuary, probably produces less phytoplankton.

The higher survival of the clams in lower subplots since the last sample in May 1972 might be related to less exposure during the period of subfreezing weather mentioned previously.

The failure of the plots in Alsea Estuary was a disappointment. If the clams had survived well, this area had a potential for several million juveniles to be planted yearly. The growth of the survivors in the plots was average.

Estuaries on the southern Oregon coast were surveyed to locate sites where Manila littleneck test plots could be established. Of the four estuaries examined, which included Siuslaw, Umpqua, Coos, and Coquille, only Coos had a sizeable area which appeared to be suitable for the establishment of Manila littlenecks. Coquille Estuary offered one area which may be suitable. Test plots will be established in these two estuaries during the next project year.

We received a request from Oregon Aqua Foods, a newly formed company involved in mariculture, for 10,000 juvenile Manila littlenecks. They plan to rear these juveniles within their mariculture system. We have agreed to supply these clams on the condition that all data on the handling facilities and the clams growth and survival will be available for our use.

We believe that the Manila littleneck offers a good potential for use in mariculture because of the relative ease of spawning the adults and rearing the larvae and juveniles. The planned use of these juveniles by Oregon Aqua Foods will be the first evaluation of rearing Manila littlenecks for commercial purposes in Oregon.

Abalone Studies

Methods

Abalone Spawning

Adult red abalone were obtained from three sources to be used for spawning in the laboratory. Animals were collected from subtidal areas in Whale Cove, on the southern Oregon coast near Brookings, and near Fort Bragg, California. Several weeks were spent trying to induce these animals to spawn. Three methods were used singularly or in combination. These methods were desication, holding the abalone dry for 1½ hours; thermal stimulation, increasing the water temperatures from ambient (10-13 C) to 15-18 C with an occasional maximum to 22C; and chemical stimulation, using potassium chloride at a rate of 1-2 grams/liter for periods of ½ - 1 hour.

Whale Cove Abalone

The intertidal and subtidal areas of Whale Cove were searched for red abalone planted as juveniles in May and June 1967. These animals were purchased from a commercial hatchery in California and planted by members of Shellfish Investigation staff to evaluate the growth and survival of juvenile abalone on the central Oregon coast. This project was taken over by the Clam-Abalone project in 1970. The juveniles recovered in June 1972 were measured, tagged, and replaced.

Results

Abalone Spawning

The Whale Cove abalone did not respond to spawning inducements. A few hundred thousand eggs were obtained from sporadic spawning, but they failed to develop even though sperm was present and fertilization should have occurred.

The abalone obtained from Fort Bragg had full gonads. The males released small amounts of sperm during the daytime in response to the spawning inducements and also during the night without inducements. There were several occasions when the abalone released large quantities of sperm. Neither the presence of sperm nor the mechanical or chemical inducements caused the females to spawn freely. The water in the tanks was changed in the morning of each day. A few hundred trochophore larvae were obtained with each change of water for a period of about three weeks. The larvae were held in two-liter beakers in a constant temperature bath kept at 14 C. The survival of these larvae was very poor although some did survive for nearly two weeks. They did not settle on glass slides coated with diatoms which were placed in the beakers.

Only one of the female abalone obtained from the southern Oregon coast responded to spawning attempts. The female was held in a 90-liter tank at a temperature of 14 C. Two liters of concentrated sperm was added to the tank. Three hours later she spawned several million eggs. The eggs were removed and carefully washed to remove excess sperm. The eggs were divided into four groups and placed in 16-liter glass carboys. Three carboys were placed in a water bath at 15 C and the fourth was placed in a water bath at 11 C. Twenty hours after spawning the eggs were examined. Development had reached the trochophore stage but the larvae were encapsuled in the egg case. The trochophores were active and were rotating within the egg. Two days after spawning a few of the trochophores had broken through the egg membrane but they did not appear to be developing normally compared with the larvae obtained from the California abalone. By the third day, it was apparent that none of the larvae were going to develop normally and they were discarded.

Whale Cove Abalone

Fifty-three red abalone were collected, measured, tagged, and replaced in the intertidal area in Whale Cove. No animals were found in the subtidal area near the

planting site. The average length of the recovered abalone was 105 mm with a range of 69-170 mm. These animals ranged from about 5-20 mm when planted. On ten of the abalone, it was possible to measure size at time of planting because of the difference in shell color. The average increase in shell length of these ten animals was 78 mm with a range of 61-95 mm.

Conclusions

Abalone Spawning

The abnormal development of the large number of eggs obtained from one female was a dissappointment. No cause for this could be determined. The eggs were handled in a manner similar to that used for bivalve eggs which has been successful. The reluctance of the other females to spawn may be related to any of several causes: the females were not in condition, the spawning stimuli were not adequate, or water chemistry was such that the females would not respond. At present, there is no way of knowing if any of these factors were related to the spawning failure of the females.

Whale Cove Abalone

The growth attained in 5 years by the planted juvenile red abalone cannot be evaluated because of the lack of data available on the growth of young abalone. Based on observations by California abalone biologists, the growth could be considered average (Dick Burge, personal communication). The recovery of only 63 abalone, indicating a survival of 1%, also cannot be evaluated. It is encouraging that some of these abalone did survive and are growing at an average rate.

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PART 2: SUMMARY OF PROJECT ACCOMPLISHMENTS JULY 1, 1970 TO JUNE 30, 1973

Introduction

The objectives of this project are to develop techniques for spawning and rearing commercially and recreationally important bivalves and abalone. The long range goal is to develop methods to mass culture these species to supplement natural production, to establish new areas of production, and to determine the feasibility of a hatchery operation for commercial purposes.

Oyster Studies

During fiscal year 1971, the oyster portion of the project was phased out. The techniques for spawning and rearing oysters in mass culture had progressed to the point that Oregon State University built a pilot oyster hatchery at the Marine Science Center to demonstrate the practicality of this type of operation to the oyster industry. Field studies concluded during the year compared the growth of laboratory-reared and imported spat in the field, evaluated tray culture at different depths, and compared string and tray culture. Results showed that after 19 months, hatchery and imported Pacific oysters averaged the same in both shell size and meat volume. Laboratory-reared Kumamoto oysters produced 9% less meat than imported Kumamoto oysters after 20 months in the field.

A group of juvenile Pacific oysters were divided into 4 lots and cultured in suspended trays at depths of 3, 6, 9, and 12-feet. At the end of a 19-month period, growth of these oysters was nearly the same at the four depths tested. Growth of Pacific oysters in trays was comparable to oysters cultured on strings hung from a boom log. After 13 months, oysters on strings suspended on a fixed rack averaged 10 mm less than a comparable group of oysters in a suspended tray.

Clam Studies

During the three-year period, the clam phase of the project was directed primarily towards developing spawning and rearing techniques for mass culture of the Manila littleneck clam. Field studies involved establishing test plots in several estuaries to evaluate suitability of selected sites for further introduction of laboratory-reared Manila clams.

Mass culture techniques for Manila clams were developed to the point where it is possible to produce large numbers of juveniles in the laboratory. We have been and will continue to refine spawning and rearing techniques to achieve maximum survival and growth of juveniles in the laboratory. One of our future objectives is to investigate the feasibility of increasing growth and survival through selective breeding.

Laboratory-reared juvenile Manila clams were planted in five estuaries in fiscal year 1972. Only in Yaquina Estuary have the test plots been successful. The average growth achieved by Manilas in these plots has been comparable to the growth of Manilas in Hood Canal, Washington. Survival was judged to be adequate.

During the fiscal year 1973, we mass planted 426,000 juvenile Manilas in one area of Yaquina Estuary to establish a population of Manila littlenecks. There are still areas in other estuaries where we will establish test plots.

Other field work, during fiscal years 1971-73, involved the monitoring of growth and survival of butter clams and native littleneck clams planted as laboratory-reared juveniles in an artificial substrate test plot. This plot, established in 1968, had crushed and river-run gravel of different sizes placed on a silt-sand tide-flat in Yaquina Bay. Results show that native littlenecks after 19 months in the plot had survival rates ranging up to 20% depending upon the gravel they were planted in.

Maximum survival of butter clams was 3.3% after 24 months in the test plots. While we have no comparisons to evaluate growth of these two species in the plot, it is felt they are achieving normal growth rates based on the appearances of growth rings on the shell. The success of this plot indicates that it is feasible to create new clam beds with dredge spoils which have a high percentage of gravel. A pilot study should be considered.

Red Abalone Studies

Red abalone are found in modest abundance on the southern Oregon coast. It was conceived that, based on the success of bivalve culturing, we could spawn and rear red abalone in the laboratory and plant the juveniles in selected areas along the southern Oregon coast to supplement natural production.

We have not been very successful in this endeavor. The techniques used for inducing red abalone to spawn gave marginal success. We induced spawning of male abalone from each group of adults we worked with, but female abalone have not responded well to inducements or, when spawning, produced non-viable eggs indicating incomplete gonad development. Only on two occasions did females spawn readily to inducements. One group of larvae developed, but survived only a week while the other group never did develop normally. Progress in this phase of the project has been unsatisfactory. Proper conditioning procedures need to be develop to allow female abalone to achieve maximum gonadal development. After this is accomplished, we feel confident that we will be able to spawn the abalone using current techniques. We have not had enough experience in handling juvenile abalone to evaluate our techniques. Our guidelines for this phase will follow those developed for bivalve larvae and juveniles plus whatever information can be obtained from the literature and from persons involved in abalone research.